^{40}Ar, eclogite and the evolution of Venus internal dynamics

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Although it is often termed Earth's 'sister planet' due to similar mass and size, Venus today probably lacks many of the characteristics typical of the Earth. This is true for example, in terms of global dynamics of the solid interior and their surface manifestation - the most interesting question here being rather 'why does Earth get plate tectonics ?' than 'why Venus does not ?' ; a key feature that models of Venusian evolution addressed, for example, deals with the apparently random distribution of impact craters implying a mean surface age of about 0.3-1 Ga. Theories about this 'resurfacing' history generally involve one of the two following scenarios:

• an episodic evolution (e.g. with plate tectonics events or periodic Rayleigh-Taylor like instabilities) with the last of such events corresponding to the global resurfacing,

• a transition from one dynamical regime to the other (layered to whole mantle, time-dependent to steady convection, plate tectonics to stagnant lid).

In this study, I consider various scenarios mimicking the several evolutions mentioned above and confront these with other constraints than the age of the resurfacing event such as the outgassing history and today's lithosphere characteristics (thickness, heat flux). Simple one-dimensional evolutions based on scaling laws (tested against fully spherical convection models in a few cases) are used for their rapidity - the most discussable aspect in these models is likely to be the treatment of magmatic transport from depth to surface.

Although the parameterized models clearly need to be extended and although the uncertainty on the constraints used here (heat flow, lithosphere thickness, argon budget in the atmosphere) is large, strong conclusions are obtained for relatively wide ranges of parameter values: among the proposed models, internal histories with no recycling of the lithosphere during at least the second part of Venus evolution are favored thus indicating that the last 'resurfacing event' should be of magmatic (rather than tectonic) origin. The relatively low argon content of Venus lithosphere as well as various estimates of the lithospheric state are well described by successful models.